

# Demythifying Contract Farming: Evidence from Rural South Africa

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## **Abstract**

*This paper intends to contribute to the on-going debate about whether and how restructured agri-food markets can provide viable market opportunities for small-scale farmers in South Africa. It aims at analyzing contract farming from the small-scale farmer perspective and at better understanding the implications for small-scale farmers regarding contractual arrangements with processing and/or marketing firms.*

*The paper, based on empirical research conducted in the Limpopo Province of South Africa and on a combination of qualitative and econometric analyses, argues however that contract farming is not a panacea for small-scale farmers. On one hand, contract farming improves agricultural production for contract farmers benefiting from increased incomes, enables better access to services and resources and creates new opportunities to participate in markets. However, on the other hand, the results, show that contract farming remains limited and mostly involves the already better-off, who have benefited from specific development paths and public support. This case study shows that contract farming by itself does not appear to provide an efficient means of reducing poverty, nor does it provide an institutional tool through which to improve rural livelihoods. It does therefore, not represent a tool for the majority of small farmers and for redressing the historical imbalances in the South African agricultural sector.*

## **Key words**

Contract farming, small-scale agriculture, poverty, South Africa

## Introduction

Poverty levels in South Africa remain high and concentrated, both socio-economically and geographically, with the previously disadvantaged communities within the rural areas particularly affected (Pauw and Mncube, 2007)<sup>1</sup>. In this context, agriculture, particularly the small-scale sector, is considered as one of the main economic sectors to revitalize the rural economy (National Planning Committee, 2010). As such, government has implemented several policies supporting the small-scale sector (DAFF, 2010). These initiatives have, however, had limited success (Anseeuw, 2004; Perret *et al.*, 2005).

It is in this context that the development of integrated value chains with the emergence of new private actors, partly a result of the global restructuring of markets and the deregulation of the agricultural sector, is seen as an opportunity for small-scale farmers. Indeed, the contractual arrangements accompanying these evolutions represent a possibility for small-scale farmers' integration into modern value chains. Contract farming is generally considered as an attractive mechanism for integrating poorer farmers into the open-market economy (Glover, 1984; Key and Runsten, 1999; Poulton *et al.*, 2010) and, subsequently, for increasing production and farm income. But, as mentioned by Poulton *et al.* (2010), it may be selective, excluding the poor and subjecting them to high risks and agribusiness normalization, while failing to increase incomes due to unequal bargaining power with the farmers losing out.

This paper intends to contribute to the on-going debate about whether and how restructured agri-food markets can provide viable market opportunities for small-scale farmers in South Africa. Based on empirical research regarding contract farming in the Limpopo Province of South Africa, the paper analyzes the determinants of participation in contracts and estimates their implications in terms of livelihoods. The South African case is particularly interesting. On one hand, due to the historical imbalances in access to land and secure tenure regimes, input and output markets, infrastructures and quality control systems, small-scale farmers face high transaction costs. Moreover, the differences in scale of trade between the small-scale farmers and agribusinesses put the farmers in a disadvantaged bargaining position (D'Haese and Van Huylenbroeck, 2005). On the other hand, the well-developed value-chains and the public supports available, in particular through land reform and positive action programmes, represent incentives and should contribute to a conducive market and production environment (DAFF, 2010).

In the first section, literature review and background information on contract farming are presented, with a specific focus on South Africa. This is followed, in the second section, by the methodology used in the research study. Through a combination of qualitative and quantitative approaches, we will establish a typology of farm households and analyze the significance and determinants of contract farming and of farm incomes. The results of these are presented in section three. These will then also lead, in section four, to wider conclusions on

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<sup>1</sup> Poverty rate indices for South Africa vary according to sources and methodologies: World Bank (2011) estimates that 22% lives on less than R524 whereas the National Planning Commission (2010) notes that 49% of the population lives on less than R283.

the role of agricultural contracts in general and in revitalizing South Africa's previously marginalized small-scale farming sector in particular.

## **Background on Contract Farming**

### **Contract Farming and Types of Agricultural Contracts**

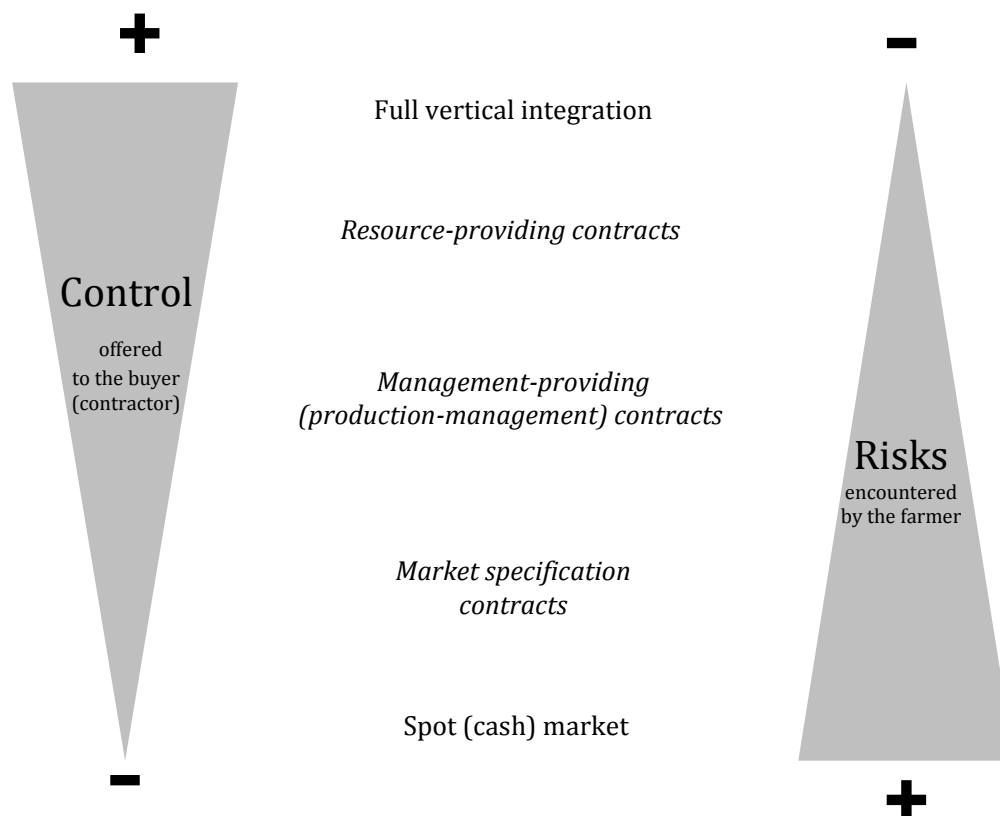
Contract farming can be defined as an agreement between a farmer and a buyer, ranging from simple oral arrangements to formal written documents, in which parties respectively commit to sell and buy specific volumes or acreages under pre-established conditions (Glover, 1984; Minot, 1986). The buyer can be a local or a transnational agribusiness (processor, exporter, retail outlet or shipper), a private plantation, a parastatal with its own production, or local merchants (greengrocers, wholesalers, hawkers, brokers etc.).

In institutional economics, contract farming is described as a hybrid agreement that positions itself between the two extremes of the institutional arrangement spectrum, namely spot markets and market integration. On spot markets, products are sold and bought immediately, at a price set during the transaction and with no involvement of the buyer in the production or in the definition of the conditions of the transaction. At the other extreme, full vertical integration implies that the buyer controls all stages of production, processing and distribution throughout the value chain. Between these, contract farming allows the buyer a measure of control (decision-rights) over production without formally engaging in the farming activities (Grosh, 1994; Ménard, 2005). The allocation of risk depends on the terms of the contracts. As such, contract farming provides a response to market failures with respect to inputs, credit, insurance, information and outputs, by reducing the associated transaction costs, monitoring, transfer of goods and bargaining and enforcement (Key and Runsten, 1999; Poulton *et al.*, 2010).

Literature on contract farming differentiates between three classic types of contracts according to their main objectives, the transfer of decision-rights and the shift of risk from the farmer to the buyer (Key and Runsten, 1999; Mighell and Jones, 1963; Minot, 1986). *Market-specification contracts* refer to pre-harvest agreements that engage a buyer in providing a market outlet to a farmer under pre-established conditions often related to price, quantity, quality and timing. Thus, the farmer delegates a part of the risk to the buyer, while keeping control over production. Both the farmer and the buyer benefit from the price premium on the quality and stability in the flow of supply of products to specified markets.

*Management-providing (production-management) contracts* are similar to marketing contracts. These contracts however delegate some of the farmer's control over the production process to the buyer. In terms of these contracts the adoption of specific farming practices (land preparation, planting dates, seedlings, fertilizers application rates and dates etc.) or the choice of post-harvest management practices will come under the technical supervision of the buyer to attain higher quality and to control the timing of output. The buyer recoups the costs of extension from the proceeds of marketing a higher-quality product according to the timing of demand. Finally, *resource-providing contracts* are the closest arrangement to full vertical integration and require not only that the buyer provide a market outlet to the farmer but also

that he delivers input packages on credit and corresponding technical assistance in its use. It results in the buyer having major control over production with the contract shifting most decision-rights and risks to the buyer (Figure 1).



**Figure 1: Typology of contracts**

Source: Adapted by the authors from Mighell and Jones (1963) and Minot (1986)

Contract farming may overcome certain constraints small-scale farmers are typically faced with in developing countries, such as access to resources (inputs, services, and information) and markets. In South Africa, black small farmers struggle with access to resources as a result of the marginalization which occurred through discriminatory policies under apartheid (Eastwood *et al.*, 2006). Today, about 1.2 million black small farmers occupy 18% of the farm land (13% communal land in the former homelands and 5% redistributed land through land reform). These farmers mainly engage in family-based, subsistence agriculture (compared to around 40,000 large-scale farmers, owning 82% of the privately owned agricultural land, characterized by highly intensive farming activities and producing 95% of the country's marketed agricultural output). Most of them lack access to resources (land, water, infrastructure, credit facilities). Consequently, contract farming could facilitate their access to information, technical assistance, credit and inputs, reduce the uncertainty around marketing their products, improve their integration into modern value-chains and consequently, increase their farm incomes (Glover, 1984; Key and Runsten, 1999; Minot, 1986; World Bank, 2007), and provide institutional mechanisms to address the difficulties

they face. However, contract farming could potentially also lead to increasing market segmentation and exclusion (Little and Watts, 1994; Porter and Phillips-Howard, 1997a, 1997b; Poulton *et al.*, 2010; Vorley *et al.*, 2007) or remain limited in terms of the number of farmers involved, limiting the overall impact (Losch *et al.*, 2010).

### **Development and scale of contract farming in South Africa**

Contract farming has a long history in South African agriculture (Karaan, 1999; Kirsten and Sartorius, 2002a, 2002b; Louw *et al.*, 2006; Porter and Phillips-Howard, 1997a, 1997b, Ortmann and King 2010). The historical development of agricultural contracts can be traced since the early 1900s in relation with the emergence of cooperatives (Ortmann and King, 2006; 2007; 2010). This highlights the significant role of contracts in the development of white commercial agriculture. Indeed, until the 1990s, white farmers benefited from input supplies (seeds, fertilizers, chemicals and credit), marketing facilities through various boards and service provision (storage, transport) organized by the cooperatives through various institutional arrangements. Due to the discriminatory policies, black farmers located in the homelands had only limited, if any, access to most domestic markets, and consequently to their contracts. They commercialized their outputs – when they were able to generate surpluses – on informal local markets within the homelands.

Contract farming in South Africa has been analyzed for small-scale farmers in traditional value chains such as tea, sugarcane, timber, tobacco, flowers and beverages (Kirsten and Sartorius, 2002b). These schemes appear however to be more the result of specific initiatives of large estate actors during apartheid and the pre-liberalization period, than what McMichael and Myhre (1991) call the “restructuring of agrifood markets”. Quantifying the scale of contract farming, whatever the level of analysis, is extremely difficult. Whereas some authors attempt to estimate the scope of its development in Africa (Grosh, 1994; Little and Watts, 1994), most studies in this respect focus on its impact on the farm and household (e.g., Bellemare, 2010a, 2010b; Maertens and Swinnen, 2009). In a study on contract farming in South Africa, Vermeulen *et al.* (2008) estimate its scale in the fresh produce sector and assesses the level of participation of small-scale farmers. This research shows that almost 80% of the volumes of fruits and vegetables supplying the South African processing industry (21% of the production) was exchanged through contracts and that between 70% and 100% of the produce sold in supermarkets were supplied under contract, while the meat and egg sectors favored full vertical integration (Vermeulen *et al.*, 2008). This study also showed that only 5% of the contracts identified involved small-scale farmers with few suppliers. These results confirm the findings of previous studies which show that contract farming, for fresh produce in particular, usually implies a small number of producers, and very few small farmers (table 1).

**Table 1: Extent of Contract farming in South Africa for selected commodities**

Sub-sector	# of farmers under contracts	# of small-scale and emerging farmers under contracts	% of South African farmers under contracts*
Sugar cane	16 045	14 445 small-scale growers (8% of sugarcane production) + 385 emerging growers	1.2%
Timber	50 000	15 000	4%
Cotton	3 000	-	0.2%
Processed fruits Snack and Nuts	2 709	209	0.2%
All Fresh Fruits and Vegetables	3 430	278	0.3%
Processed Vegetables	350	87	ns

Sources: authors compilation from Vermeulen 2008; FAO 2004, South African Sugar Association 2011 and FAO Expert Consultation on Contract farming in Africa, Johannesburg, South Africa (04 – 07 May 2009).

\* The Department of Agriculture, Forestry and Fisheries' annual report 2009/10 estimates 40 000 commercial farm units in 2007 and 1.2 million small-scale farms in the former homelands.

## Methodology

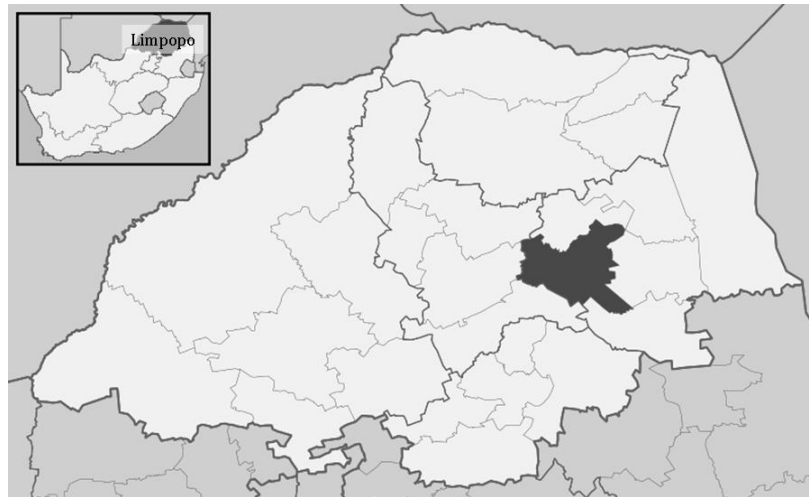
Measuring the contribution of agricultural contracts to farmers' welfare levels is methodologically challenging. Contracts are often not randomly distributed among households (Barrett *et al.*, 2010) and their access needs to be instrumented in a regression analysis of its impact on welfare (Bellemare, 2010b). In this paper, a three-step selection model is developed, addressing the determinants of access to contracts, as well as the decision to market produces, while estimating the impact of contracts on income and not on welfare. Secondly, the econometric model is entwined with a qualitative approach that studies a typology of households and their development paths. This enables us to draw more informed conclusions on the reasons why some farmers are being excluded from markets and/or contract farming. The combination of standard econometric models with qualitative analyses is particularly original and relevant.

## Site selection and sample

Data for this study was collected from farm households in the Greater Tzaneen Municipality in the Limpopo Province<sup>2</sup> (Figure 2). Within the greater municipality, the survey was conducted in the region of Nwa'Mitwa which includes the settlements of Mandlakhazi, Mbekwani, Nwa'Mitwa, Nwadjaheni and Babanana as well as the private farms surrounding the community (Jaffray, Welverwacht, Taganashoek, La Dauphine, Duplex and Uitzoek).

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<sup>2</sup> Limpopo Province is located in the North of South Africa. It is a typical developing area, characterised by the export of primary products and the import of manufactured goods and services. It is one of the poorest regions of South Africa.



**Figure 2: Location of the study area**

The selection of the study area was based on the following criteria:

1. Agro-climatic conditions and importance of agriculture

The area is characterized by relatively good agro-climatic conditions with a tropical/semi-arid climate (average temperature of 25°C, with annual rainfall of between 500 and 700 mm) and by relatively homogeneous soils (alluvial and sandy on the top and flat areas, clay soils in the lower lying areas). Despite a distinct dry season, crop production is possible throughout the year under irrigation. As a result, agriculture is well developed and the most important economic activity in the Mopani District where the study area is located<sup>3</sup>.

2. Historical background, land characteristics and poverty prevalence

The Southern part of Nwa'Mitwa is located on tribal lands that were part of the Gazankulu Homeland. Agriculture is representative of the overall prevailing situation in the former Homelands, consisting of small plots with communal land tenure, cropping and livestock systems based on traditional practices, farming activities dedicated to family consumption, high demographic and land pressure etc. Most households face a daily struggle with poverty, particularly due to the high average age of the population as well as general under- and-unemployment. The Northern part consists of commercial farms. This sub-region is subject to land claims and some governmental projects have been implemented.

3. Market proximity, off-farm jobs and contract farming opportunities

The proximity to commercial farms both located in the study region and in the Great Letaba River Valley, one of the leading regions for fruit and vegetable production, has enhanced the development of agricultural wage labour opportunities and the presence of contract farming. The population of the study area is estimated at around 16 000 households (Municipal Demarcation Board, 2006) of which, according to our findings, i) about 2000 are involved in

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<sup>3</sup> Mainly citrus and subtropical fruits are produced in the area for both domestic and export markets. The area is also known for its tomatoes (constituting approximately 60% of tomato production in South Africa).

agriculture, including livestock and self-consumed cropping activities in gardens and ii) 82 are private land owners. A probability sample was not possible because exact lists of community members were unavailable. It was consequently decided to conduct:

(a) 110 questionnaires among a random group of respondents geographically spread over the area, which allowed, considering the available time and resources, for capturing the existing diversity and to provide the necessary information for the establishment of a typology. The survey was random but the number of commercial and contract farmers were purposefully higher. Four cases were deleted from the analysis due to missing data, resulting in a data set of 106 valid cases;

(b) 40 complementary interviews among selected households identified during the first 110 interviews in order to better understand their specific trajectories;

(c) 36 complementary questionnaires among farmers engaged in contracts and also identified in first round of interviews and

(d) 239 additional short questionnaires to check how representative the results are in relation to the size of the population in the region.

The dataset is rich and representative regarding the diversity of farming systems and contracts in the study area. Firstly, it combines quantitative and qualitative data. Secondly, as we will show in the analysis, it covers a whole range of farming systems ranging from less developed and subsistence small-scale systems to more advanced large-scale and commercial ventures. Thirdly, it includes farmers with and without contracts and assesses the type of agreements they are involved with. Finally, the dataset enables comparison across farm households with different land tenure regimes and different levels of governmental support, including beneficiaries from land reform programmes.

### **Qualitative data analysis**

Two methodological approaches were used to analyze agriculture and rural livelihoods. Firstly, an agrarian systems diagnostic approach was implemented in order to characterize the agro-ecological, technical, historical and socioeconomic factors influencing the transformation of the rural environment (Cochet and Devienne, 2004; Dufumier, 1996). Then agricultural practices were analysed (combinations of crops and livestock and their productivity levels) which were subsequently linked to the asset endowment and households' development paths to establish a consistent typology. Secondly, a livelihood approach was applied to each identified type of household, aimed at understanding the combination of activities and income sources.

### **Quantitative analysis**

The econometric approach aimed at analyzing the determinants of the uptake of contracts and contract farming's contribution to the households' farm income. The analysis was done in three stages. In the first instance, a probit model was used to analyze the uptake of contracts. The second step (first model of a Heckman model) was a probit analysis of factors determining whether or not farmers commercialize their agricultural produce (if not, they are considered to be subsistence farmers). The third step (second model of the Heckman model)



was a regression analysis of the determinants of farm income for farmers participating in markets. The independent variables included the probabilities of having a contract (saved results of the first probit model) and the inverse mills ratio that was saved from the second probit model. The estimation of the probit model as well as the Heckman procedure (models two and three were jointly estimated) was done using Stata. A description of the Heckman model is given in Annex 1.

The rationale behind this approach is the latent endogeneity and selection-bias issues around the uptake of contracts and commercialization of on-farm income. While market orientation, as opposed to the choice of subsistence production, is intrinsically linked to farm income, we suspected selection biases and corrected these by estimating a Heckman model (Greene, 2000). We also suspected that the uptake of contracts would be endogenous to farm income as a buyer's decision to procure from a certain region and within that region from a number of sellers, is not random (Barrett *et al.*, 2010; Bellemare, 2010b). Because the analysis seeks to test whether contract farming increases farm income, we needed to instrument the uptake of contracts to address these potential endogeneity problems while controlling for the decision to sell agricultural produce. Following Wollni and Zeller (2007), we introduce the probabilities obtained from the probit model on uptake in the farm income model. It is worth noting that farmers who had contracts were marketing their produce, while not all farmers who were marketing, had contracts. Contract uptake is instrumented by the importance of off-farm income in the total household income.<sup>4</sup> Furthermore, there is no theoretical reason to assume a causal relationship between the share of income from off-farm sources and agricultural income. Likewise, the likelihood to market produce is instrumented by the level of transfers; high social grants and remittances may influence the likelihood that farmers commercialize, but they are exogenous and arguably not necessarily causally linked to farm income.

The independent variables selected for the first probit model are similar to those commonly used in literature for similar models (Bolwig *et al.*, 2009; Miyata *et al.*, 2009; Wollni *et al.*, 2010; Wollni and Zeller, 2007) namely (a) household characteristics (household size, age and gender of the head); (b) assets endowments (land area, size of the cattle herd) and (c) share of off-farm income in total income.

The model for household *i* then becomes:

$$C_i = \alpha_0 + \alpha_1 \text{householdsize}_i + \alpha_2 \text{age}_i + \alpha_3 \text{age\_squared}_i + \alpha_4 \text{gender}_i + \alpha_5 \text{land\_area}_i + \alpha_6 \text{cattle}_i + \alpha_7 \text{share\_income\_off\_farm}_i + u_i \quad (1)$$

with  $C_i$  being a dummy variable (0/1) indicating if the household has a contract or not, and  $u_i$  being the error term. The probability of  $C_i=1$  is calculated by a probit model similar to the first step of the Heckman model given in equation (2') in Annex 1.

Independent variables for the second probit model were similar to exogenous household characteristics in the first model (household size, age and gender of the head), supplemented

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<sup>4</sup> We assume that off-farm income is exogenous to farm income at household level because it consists mainly of welfare grants and remittances. In the case of cross-financing, livelihood diversification (increasing the share of off-farm income in total income) may increase agricultural income. It is equally possible however, that farm income may decrease as the share of off-farm income increases, in those instances where the off-farm income satisfies the household's utility levels.

with the level of education of the head and income from transfers. As mentioned above, we consider the two latter variables as relevant because these additional income sources will determine the choice of farming system without directly influencing the farm income.

The model is for household  $i$ : Market participation  $M_i =$

$$\beta_0 + \beta_1 \text{householdsize}_i + \beta_2 \text{age}_i + \beta_3 \text{age\_squared}_i + \beta_4 \text{gender}_i + \beta_5 \text{education}_i + \beta_6 \text{social\_grants}_i + \beta_7 \text{remittances}_i + \beta_8 \text{rainfed}_i + v_i \quad (2)$$

with  $v_i$  being the error term. This function is the first step of a Heckman selection model as explained in Annex 1.

Agricultural income is regressed against (a) the household structure (age, gender), (b) farm characteristics (number of active people on the farm, land, access to irrigation and land tenure regimes) and (c) the probability of access to contracts

The model then becomes for household  $i$ :

$$Y_i = \gamma_0 + \gamma_1 \text{active\_members}_i + \gamma_2 \text{age}_i + \gamma_3 \text{gender}_i + \gamma_4 \text{land}_i + \gamma_5 \text{private\_tenure}_i + \gamma_6 \text{land\_reform\_beneficiaries}_i + \gamma_7 \text{rainfed}_i + \gamma_8 C_i + \gamma_9 IM_i + w_i$$

with  $IM_i$  being the inverse mills ratio/lambda, and  $w_i$  the error term.

The second step of the Heckman procedures is expressed by equation (1') and solved as presented in Annex 1, for those households who are participating in the market. It should be noted that due to the relative low number of cases in this second step, the number of variables were limited and the results were interpreted with care. However, the outcome of the econometric models is confronted with the qualitative data analysis.

## Results

### Household Typology

From the 106 households interviewed, eight types of farming systems were identified (Table 2). Four criteria were used: (i) the size and the type of land (garden, communal area, private land); (ii) the commercialization of agricultural products, included the buyers (spot markets, local merchants, supermarkets, processors, export agents) and the destination of the products when sold (local, domestic, export markets); (iii) the combination of crops and livestock (share of staple food, of fruits and vegetables, of livestock in the farm production value) and asset endowment (equipments, irrigation systems etc.) and (iv) access to and the importance of off-farm income.

**Table 2: Typology of farming households in the Greater Tzaneen Municipality**

	n*	% of the sample	% of HH** in area
Micro-farmers cultivating residential gardens for self consumption, depending on off-farm activities, remittances and social grants	15	14.2%	53.8%
Subsistence small-scale farmers depending on off-farm income, combining staples for self-consumption and vegetables for local markets	28	26.4%	39.6%
Small-scale producers of staples and F&V for local markets, depending on off-farm activities and social grants	6	5.7%	4%
Medium-scale producers specialized in vegetables production for the local and domestic markets	24	22.6%	1%
Emerging industrial chicken and vegetables producers	16	15.1%	0.2%
Extensive commercial farmers, producers of fruits mainly for the domestic market	11	10.4%	1%
Intensive commercial producers of fruits and vegetables for the domestic and export markets	6	5.7%	0.4%
<b>Total</b>	<b>106</b>	<b>100%</b>	<b>100%</b>

Notes: \*Number of detailed questionnaires to a random group of respondents allowing for the capturing of the diversity in household types. \*\*Based on the results of the 239 short interviews conducted and being representative of the population in the study area.

***Micro-farmers cultivating residential gardens for self consumption, depending on off-farm incomes (n=15)***

The micro-farmer group is very heterogeneous in terms of livelihoods. These mostly female headed households implement survival strategies to cope with very low incomes and take any opportunity that allows them to improve their livelihoods such as small irregular jobs in the service sector in the community, casual agricultural labour, social grants and remittances (with the younger, active population often having migrated). However, despite engaging in these diverse activities, these households hardly succeed in generating an income above the poverty line. In terms of farming, they have no or very poor access to land and consequently rely only on the cultivation of residential gardens. They combine starchy staples and vegetable production for family consumption, producing only during the rainy season due to a lack of access to irrigation water. As a result, farming activities are limited and contributes only marginally to this group's subsistence (21% of global income). With insufficient access to assets and insufficient production, this group is mainly excluded from markets and farming provides only a basis for food security.

***Subsistence small-scale farmers depending on off-farm income, combining staples for self-consumption and vegetables for local markets (n=28)***

The second group consists of couples composed of a retired person and an active person engaged in a permanent activity (small business). Social grants or off-farm income was invested in an irrigation system which provides water for domestic use, for the sale of drinking water to the community and for irrigation purposes (manual only). Unlike the micro-farmer group, these households have access to a plot of arable land in the communal lands (on

average one hectare), allowing them to cultivate staples and vegetables and to keep an orchard (mangoes). They also have a small herd of cattle that graze on communal land and fatten pigs. The produce is sold on spot markets within the community or to local merchants. The farming activity allows them to have food and a financial basis but for most of them, farming is not considered to be a productive activity (17% of total income). They furthermore have no investment capacity and heavily rely on social grants for their subsistence.

***Small-scale producers of staples and fruits and vegetables for local markets, depending on off-farm activities and social grants (n=6)***

The third group combines small-scale farming (28% of global income), off-farm activities (taxi, small business) and social grants, which represent a significant part of their income (34%). Off-farm income, invested in an irrigation system, has allowed them to develop a marketable all year round vegetable production. These households have access to a plot in the communal area (average size 1.8 hectares) which they cultivate in addition to a garden. Products are sold on spot markets or to local merchants. For this group, farming is a productive activity and the basis of their livelihoods; they would like to develop their farming activity if their constraints can be overcome (limited access to resources, lack of credit, difficulties to collect and transport their products to markets etc.).

***Medium-scale producers specialized in vegetables production for the local and domestic markets (n=24)***

These households are better endowed (largest plots in communal lands) and due to more efficient infrastructure (private borehole, irrigation systems, tractor and private vehicle) they were able to develop a marketable vegetable production (up to three cycles per year) which they sell to local merchants, to fresh produce markets or under formal contracts to supermarkets (*organic production-management contracts*), to processors or restaurants (*marketing contracts*). As a result of successful but expensive practices, farming has become the pillar of their livelihood (67% of total income), the rest being non-farm sources. Farming is a profitable means of existence to them but without the massive support or the opportunities from which they benefitted on the basis of their personal social networks in order to access both production factors and market opportunities, or both, they would not have been able to develop this activity.

***Emerging industrial chicken and vegetables producers (n=16)***

These households are specialized in intensive vegetable production under *management production contracts* with agribusinesses and/or industrial broiler production under *resource providing contracts* with a local agribusiness (Bushvalley). Agriculture is their only economic activity. The viability and the sustainability of this specialized and intensive but expensive farming system is questionable, both in agro-ecological as well as economical terms. It is not clear if the farmers engaged in this production system would have had the means to invest and renew their equipment and to develop an economically sustainable activity without massive external (mostly governmental) support.

### ***Extensive commercial farmers, producers of fruits mainly for the domestic market (n=11)***

Extensive commercial farmers combine an independent or a qualified permanent off-farm activity and managerial farm requiring numerous workers. They are well equipped with an operational irrigation system and a tractor. They have specialized in extensive mango production (low use of inputs and workforce). Mangoes are usually harvested green to be delivered to local processors or sold ripe to merchants, fresh produce markets or exporting agents. Some of them have contracts (*marketing*) which are usually verbally concluded.

### ***Intensive commercial producers of fruits and vegetables for the domestic and export markets (n=6)***

The households of this last group are specialized in managerial farming. They have developed an intensive (in terms of labor, capital and inputs) production of fruits under irrigation. They own tractors, greenhouses, warehouses and a packing unit each to satisfy the requirements and the standards of their buyers (local merchants, processors, fresh produce markets and exporting agents) with whom half of them have various types of contracts (mostly *marketing* but also *production-management contracts*). Their activities are concentrated on large areas of private land. They combine their production activities with extensive cattle breeding on private pastures.

Table 2 also presents the distribution of the six types, based on a shorter survey conducted among a larger number of farmers in the study area (n=239). The resulting distribution differs from the one based on the long survey. The micro-farmers seem to be the largest group (53.8%) followed by subsistence small-scale farmers (39.6%). From the 106 farmers in the analysis that participated in the long interview, medium-scale farmers (1%), emerging industrial chicken producers (0.2%), and intensive (0.4%) and extensive (1%) commercial farmers seem to be overrepresented.

### **Extent and characteristics of contract farmers**

The extent of contract farming in the region remains limited with only 36 farmers (34% of the interviewees) having at least one contract, whether verbal or in writing. Following our findings in the short survey, contract farmers represent less than 1.2% of the total number of farm households in the region. The limited extent of contract farming can be explained by the fact that, as shown by the typology analysis, the majority (54% of the interviewees) are micro or small-scale subsistence oriented farmers. As they do not participate in markets they are also excluded from contract farming, as confirmed in Table 3 which links the farm household typology with the participation in markets, contracts and the destination of the agricultural produce.

**Table 3: Buyers, contracts, and types of households**

	Types of buyers	% each type have at least one contract	Types of agricultural contracts
Micro-farmers	No sale	0%	No contract
Subsistence small-scale	No sale	0%	No contract
	Spot markets		
Small-scale producers	Spot markets	0%	No contract
	Local merchants		
Medium-scale producers	Local merchants	57%	No contract
	Fresh Produce markets (FPM)		No contract
	Restaurants		Informal marketing agreements
	Supermarkets		No contract or formal organic production-management contracts
	Processors		Informal marketing agreements or formal production-management contracts
Emerging farmers	Local merchants	100%	No contract or informal agreements
	Road-side stalls		Informal marketing agreements
	FPM		No contract or informal marketing agreements
	Supermarkets		Formal organic production-management contracts
	Processors		Informal agreements or formal production-management contracts
Extensive commercial farmers	Local merchants	27%	No contract
	FPM		No contract or informal marketing agreements
	Processors		Informal gentlemen agreements
	Exporting agents		Formal market-specification contracts
Intensive commercial farmers	Local merchants	50%	No contract or informal gentlemen agreements
	FPM		No contract or informal gentlemen marketing agreements
	Processors		Informal agreements or formal marketing or production-management contracts
	Exporting agents		Marketing contracts

Tables 4 and 5 compare the mean values of major characteristics of contract farmers and non-contract farmers. The two groups differ significantly in their demographic characteristics, asset endowment and income structure. Contract farmers seem to have smaller households (with less older members and more children) and are led by younger heads (mostly male); they have better access to land, mostly under private tenure or in land reform schemes and all of them have access to irrigation (through various types of irrigation systems), with larger cattle herds and higher agricultural incomes. Among the group of non-contracted farmers we count more female headed households with significantly lower levels of education, less land (consisting mainly of gardens) and with a greater dependency on social grants.

**Table 4: Comparison of means between contract and non-contract farmers (standard deviation in brackets)**

	Contracted farmers (n=36)	Non contracted farmers (n=70)	T-stat
Household size (nb)	2.56 (1.92)	5.17 (3.11)	5.338***
Share children in household (%)	14.41 (17.76)	6.88 (18.02)	2.049**
Age of household head (years)	50.42 (11.84)	57.41 (14.47)	2.500**
Available land (ha)	98.04 (106.43)	20.17 (63.60)	-4.035***
Cultivated land (ha)	36.58 (63.76)	10.69 (30.98)	-2.300***
Share cultivated (%)	41 (33)	92 (22)	8.197***
Number of cattle	19.03 (43.88)	4.26 (13.28)	-1.974*
Agricultural income (R/year)	2,095,423 (3,122,966)	143,956 (600,139)	-3.714***
Remittances received (R/year)	2,666 (5,928)	4,670 (14,609)	0.789
Social grants received (R/year)	4,369 (6,991)	8,314 (7,714)	2.572**
Total income (R/year)	2,115,694 (3,115,194)	171,919 (601,174)	-3.708***
Share of income from off-farm source (%)	16.5 (28.5)	63.7 (33.9)	7.568***

Note: \*\*\* significant at 1%, \*\* significant at 5%, \* significant at 10%

**Table 5: Comparison of shares (%) of determinants between contracted and non-contracted farmers**

	Contracted farmers (n=36)	Non contracted farmers (n=70)	Chi-square-stat
Gender household head (% male)	83	47	12.915***
Access to off-farm income (% yes)	56	89	14.795***
Education above primary level (%yes)	94	33	36.276***
Rain-fed production (% yes)	11	50	14.460***
Private land tenure (%)	50	17	
Communal land tenure (%)	14	10	
Gardens (%)	0	63	
Land reform (%)	36	0	
Garden + communal land (%)	0	10	60.893***

Note: \*\*\* significant at 1%, \*\* significant at 5%, \* significant at 10%

<sup>a</sup> Chi-square test for land reform versus contract farming

In the probit model we explain participation using several variables which are expected to determine households' ability to engage in contracts. The probit model is highly significant and predicts almost 88% of the observed engagement in contracts (Table 6). The model supports the conclusions of the typology analysis and finds that land size increases the probability to engage in contracts while the share of off-farm income in the total income decreases this probability. The model confirms that farmers with low land endowments

(micro-subsistence and small-scale farmers) are more likely to be excluded from contract farming.

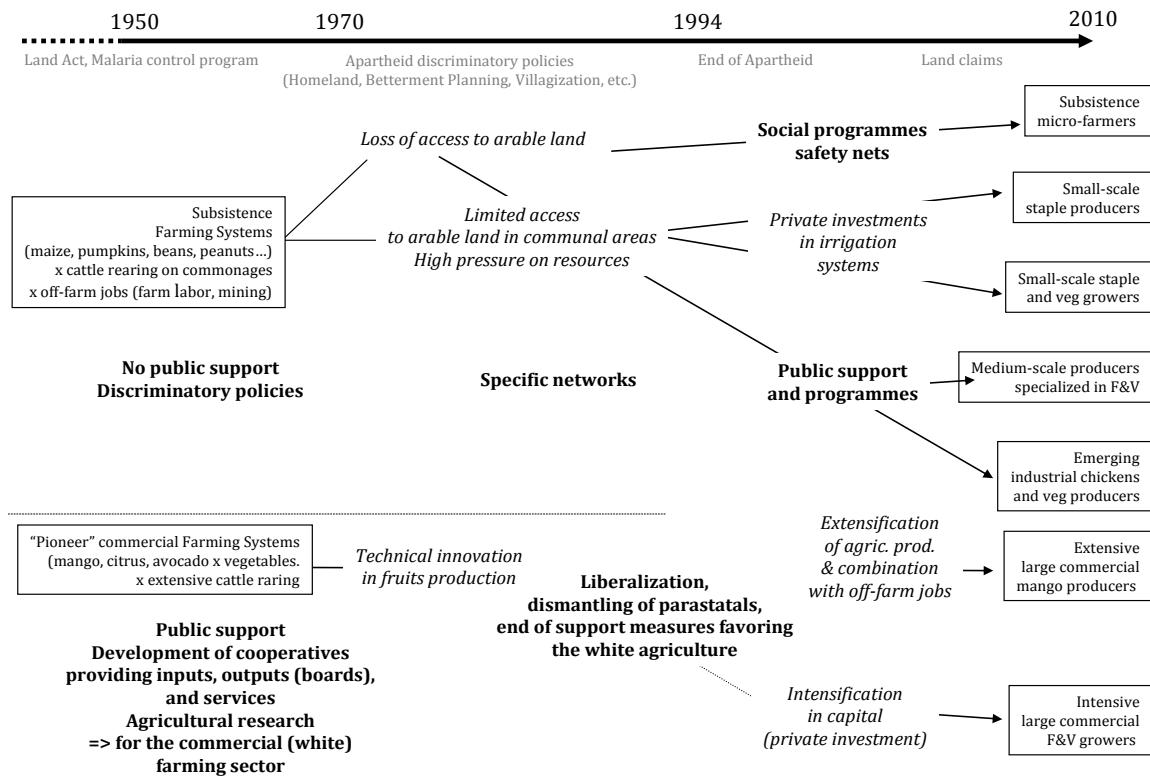
**Table 6: Probit model of uptake of contracts (0: no contract; 1: contract)**

	Coefficient	Robust std. error	z-stat
Household size	-0.247	0.086	-2.87***
Age of household head (yrs)	0.201	0.091	2.21**
Age squared (yrs <sup>2</sup> )	-0.002	0.001	-2.40**
Gender of household head (1:male/2:female)	-0.248	0.352	-0.70
Share off-farm income (%)	-0.012	0.007	-1.68*
Log land size (log ha+1)	0.282	0.138	2.04**
Cattle (number of heads)	0.001	0.005	0.19
Constant	-3.870	2.229	-1.74*
N= 106			
Wald chi <sup>2</sup> =36.67			
Pseudo R <sup>2</sup> = 0.519			
Correctly classified 87.5%			

The combined quantitative and econometric analysis thus assists in classifying the contract farmers into two categories. The first group of households consists of large-scale commercial farmers. The analysis of their trajectories (see Figure 3) shows that they access contracts as preferred suppliers of processors, supermarkets and exporting agents as a result of a good asset endowment base (large cultivated areas on private land; efficient irrigation systems and equipment). They have succeeded in equipping the farm and becoming, relatively speaking, highly productive due to the public support they received during apartheid (subsidized interest rates, tax concessions and price support combined with strong institutional arrangements with cooperatives). After liberalization, the deregulation of markets and the dismantling of parastatals, only the largest and the more efficient farmers in this group were able to meet the required volumes and quality (norms and safety standards) and succeeded in remaining preferred suppliers.

The second group, which is the target group of the project, consists of smaller-scale farmers located on both private (redistributed) land and communal areas. The analysis of their trajectories shows convergent trends. Most of them accessed support measures as a result of social networks established before the end of apartheid (for example, access to land and support as public workers or as decision makers in the Homelands). Others benefited from recent public support in the context of Broad-Based Black Economic Empowerment for Agriculture and other affirmative action programmes.





**Figure 3: trajectories of households per types of farming systems**

Source: Authors

The trajectories of the emerging vegetable and broilers producers are good examples of how some small-scale farmers succeeded in concluding contracts in the study area (Figure 3). Seven individual farmers received productive farmland in 2002 through the Land Reform's Settlement Land and Acquisition Grant programme, complemented with loans from the Land Bank. After acquisition their farms collapsed due to, amongst others, inadequate experience and institutional support. In 2005, the Limpopo Department of Agriculture intervened with a multi-million Rand poultry project as part of the agri-BEE drive, including the construction of environmentally controlled houses with a carrying capacity each of 40 000 broilers per 32 day cycle (Anjuère and Boche, 2009; Business Report, 2010). One of the conditions for the farmers to benefit from the infrastructure was the conclusion of a five year *resource-providing contract* which the Department of Agriculture signed with the processor, Bushvalley. Broiler production effectively started in 2007. The contract terms include the following: Bush Valley is to provide farmers with all the required inputs (poultry equipment, one day old healthy broiler type chicks from a local hatchery, high quality balanced foodstuffs, poultry litter, disease prevention/control medicines etc.) and a strict monitoring plan for feeding and managing the chickens. All costs (input, transport and processing) are to be deducted from the amount producers are paid; the price is not pre-established and depends on the weight of the chickens. In addition to the provision of technical assistance, quality and hygiene inspections are to be conducted to ensure the highest quality of the products delivered (Anjuère and Boche, 2009; Limpopo Provincial Government, 2007). The project leaders also benefitted

from intensive training regarding poultry production in environmentally controlled facilities, provided through the DoA's comprehensive agricultural support programs.

### **Determinants of agricultural income**

A Heckman model was used in order to test whether contracts could improve livelihoods. The first step of the model (Table 7) is a probit model of the determinants of the likelihood that the farmers commercialize their produce or not. Indeed, it is obvious that if a farmer is not able to generate marketable output, he won't be able to participate in any arrangement; testing if contract farming is a determinant of the farm income is in that case irrelevant. The first step of the model thus shows that an education above primary level is an important determinant of commercialization. Furthermore, households that receive larger social grants and who do not have access to irrigation infrastructure are less likely to commercialize any agricultural produce, which also corresponds with the results of the qualitative analysis.

**Table 7: Probit model of commercializing agricultural produce (0: no sales; 1: sales)**

<b>STEP 1 of Heckman model</b>	<b>Coefficient</b>	<b>Std. error</b>	<b>z-stat</b>
Household size	0.052	0.063	0.83
Age of household head (yrs)	0.062	0.144	0.43
Age squared (yrs <sup>2</sup> )	-0.0005	-0.001	-0.39
Gender of household head (1:male/2:female)	-0.638	0.556	-1.15
Secondary education or more (1:yes)	1.615	0.537	3.00***
Log social grants (R)	-0.293	0.168	-1.74*
Log remittances (R)	0.044	0.050	0.87
Rain-fed production (1:yes)	-0.926	0.459	-2.01**
Constant	1.524	4.138	0.37

The second step of the model is a regression of the determinants of farm income (Table 8). The latter seems to be positively influenced by the number of active members on the farm, the level of specialization in agriculture, the size of the cultivated land and whether this land was acquired under private tenure or land reform. These determinants are all "classic" structural variables influencing farm income, as widely commented on in the literature. Further literature (Eaton and Shepherd, 2001; FAO, 2005; IFAD, 2003; Little and Watts, 1994; World Bank, 2007) confirms that contracts positively influence farm income.

**Table 8: Regression results for determinants of agricultural income (dependent variable: log of income from agriculture)**

STEP 2 of Heckman model	Coefficient	Robust std. error	z-stat
Household members active on farm	0.607	0.222	2.73***
Age of household head (yrs)	-0.012	0.013	-0.94
Gender of household head (1:male/2:female)	0.482	0.402	1.20
Probability of contract	2.016	0.881	2.29**
Log land size cultivated (log ha+1)	0.535	0.176	3.04***
Private land tenure (1:yes)	1.141	0.638	1.79*
Land reform beneficiaries (1:yes)	1.796	0.615	2.92***
Rainfed production (1:yes)	-0.203	0.500	-0.41
Constant	7.623	1.000	7.62***
Inverse mills - Lambda	-0.597	0.560	-1.07
n= 106			
Censored obs = 31			
Uncensored obs = 75			
Wald ch <sup>2</sup> =130.65			
Rho=-0.443			
Sigma= 1.348			

The analysis of the Heckman model confirms that farmers who generate higher farm incomes are also better endowed with respect to capital and production factors (land, private tenure, equipment etc.). The qualitative analysis (Figure 3 and Table 3) suggests that these farmers engage in contracts for different reasons: i) they are more concerned with ensuring stability in the flow of produce to specified markets rather than with accessing production factors, credit and other inputs as they already have access to these; this is specifically the case for commercial farmers who participate in either informal agreements or formal *marketing contracts*; ii) contract farming is ‘part of the deal’ for gaining access to development programmes (agri-BEE, Public-Private Partnerships, land reform programmes, other public programmes for rural development, small-scale enterprises and agriculture, etc.), as illustrated by the emerging farmers. In this case, contract farming is a *sine qua non* condition for the farming system which is largely based on public support.

## Conclusion

The objective of this paper was to contribute to the on-going debate about whether and how contract farming can provide viable market opportunities for small-scale farmers in South Africa.

The results show, however, that contract farming is not a panacea for small-scale farmers. They highlight that contracts mostly involve the already well-off, who are either large-scale managerial commercial farmers having benefited from public support during apartheid and which enabled them to become highly productive, well-equipped and well-inserted in output markets, or medium-scale farmers who have benefited from case-specific public programmes and/or social or political connections. Both the qualitative and quantitative analyses confirm the existence of entry barriers for small-scale farmers in concluding contracts (production and commercialization scales, education and asset endowments such as access to land and irrigation). As such, although significant changes have occurred in South African agriculture,

small-scale farmers with limited access to assets and who rely mainly on diversified incomes (part time work, social grants etc.) to sustain their livelihoods, remain excluded and thus often marginalized. Hence, the results support the concerns around the inclusivity of contract farming posed elsewhere in the literature (Losch *et al.*, 2010; Poulton *et al.*, 2010; Vorley *et al.*, 2007 amongst others).

The results lead us to emphasize the need for disaggregated analyses of the farming systems, of their different structures, their diverse roles and, subsequently, of their different needs, policy measures and support systems. They also question the effectiveness of contract farming as a “mythic” tool to integrate small-scale farmers into restructured markets and modern value-chains and to reduce rural poverty and inequality. The heavy support and subsidized measures necessary to make contract farming work for the poor casts further doubt on the viability of these instruments. Rethinking instruments is a must in order to support the different types and roles of agriculture in the context of social dependency and exclusion of productive income-generating activities affecting the rural poor. This is particularly the case in South Africa, marked by its agrarian history. It applies however, also to other developing countries where the majority of farmers is engaged in agriculture solely for subsistence, within a complex and strongly diversified livelihood system.

## References

- Anjuère, M., Boche, M., 2009. Diagnostic agraire des coteaux de la rivière Nwanedzi, province du Limpopo, Afrique du Sud, *Agriculture comparée et Développement rural*. AgroParisTech/University of Pretoria/CIRAD/NAMC, Paris, France.
- Anseuw, W., 2004. La reconversion professionnelle vers l'agriculture marchande et politiques publiques. Le cas des mineurs du Northern Cape. Université Pierre Mendès-France Grenoble, France.
- Barrett, C.B., 2008. Smallholder market participation : Concepts and evidence from eastern and southern Africa. *Food Policy* **33**, 299-317.
- Barrett, C.B., Bachke, M.E., Bellemare, M.F., Michelson, H.C., Narayanan, S., Walker, T.F., 2010. Smallholder participation in agricultural value chains: Comparative evidence from three continents, in: version, W.p. (Ed.), *Accessed by SSRN: <http://ssrn.com/abstract=1733942> January 2011.* .
- Bellemare, M.F., 2010a. Agricultural extension and imperfect supervision in contract farming: evidence from Madagascar. *Agricultural Economics* **41**, 507-517.
- Bellemare, M.F., 2010b. As you sow, so shall you reap: the welfare impacts of contract farming, in: MPRA Paper No. 23638, p.J. (Ed.). Munich Personal RePEc Archive, Accessed by <http://mpa.ub.uni-muenchen.de/23638/> January 2011.
- Bolwig, S., Gibbon, P., Jones, S., 2009. The economics of smallholder organic contract farming in tropical Africa. *World Development* **37**, 1094-1104.
- Business Report, 2010. Chicken house needs funding to survive, *Business Report*
- Cochet, H., Devienne, S., 2004. Comprendre l'agriculture d'une région agricole: question de méthode sur l'analyse en termes de systèmes de production, in: SFER (Ed.), *Les systèmes de production agricole: performances, évolution et perspective*, Lille.

- D'Haese, M., Van Huylenbroeck, G., 2005. The rise of supermarkets, friend or foe of rural development. Evidence of consumption data in the Transkei area, South Africa. *Food Policy* **30**, 97-113.
- Dufumier, M., 1996. Les projets de développement agricole - Manuel d'expertise. Karthala, Paris.
- Eastwood, R., Kirsten, J., Lipton, M., 2006. Premature deagriculturalisation? Land inequality and rural dependency in Limpopo province, South Africa. *The Journal of Development Studies* **42**, 1325-1349.
- Eaton, C., Shepherd, A., 2001. Contract farming – Partnership for growth, *FAO Agricultural Ser-vices Bulletin* **145**.
- FAO, 2005. Marchés des produits de base: tendances mondiales, retombées locales.
- Glover, D.J., 1984. Contract farming and smallholder Outgrower Schemes in Less-developed Countries. *World Development* **12**, 1143-1157.
- Greene, W.H., 2000. *Econometric Analysis*. Fourth Edition. Prentice Hall, New Jersey, USA.
- Grosh, B., 1994. Contract Farming. An Application of the New Institutional Economics. *Journal of African Economies* **3**, 230-261.
- IFAD, 2003. Promoting Market Access fro the Rural poor in order to achieve the Millennium development goals. IFAD, Rome, Italy.
- Karaan, A., 1999. Bridging the small-big divide: A transaction cost approach to enterprise modeling for mussel mariculture in Saldanha Bay. *Agrekon* **38**, 680-692.
- Key, N., Runsten, D., 1999. Contract farming, Smallholders, and Rural Development in Latin America: The Organization of Agropocessign Firms and the Scale of Outgrower Production. *World Development* **27**, 381-401.
- Kirsten, J., Sartorius, K., 2002a. Can Small-scale Farlmers be Linked to Agribusiness? The Timber experience. *Agrekon* **41**, 295-325.
- Kirsten, J., Sartorius, K., 2002b. Linking Agribusiness and Small-scale Farmers in Developing Countries: Is there a new role for contract farming? *Development Southern Africa* **17**, 503-529.
- Limpopo Provincial Government, 2007. Limpopo MEX for Agriculture, MME Dikeledi MAGADZI to hand-over poultry projects.
- Little, P., Watts, M., 1994. Living under contract: Contract Farming and agrarian transformation in Sub-Saharan Africa. Madison: University of Wisconsin Press.
- Losch, B., Fréguin-Gresh, S., White, E., 2010. Structural Dimensions of Globalization on Agriculture and Rural Development: Synthesis Report. RuralStruc program, *Working paper*. World Bank, Washington DC.
- Louw, A., Chikazunga, D., Jordaan, D., Biénabé, E., 2006. Restructuring food markets in South Africa: Dynamics in context of the tomato sub sector, *Working Paper. Regoverning markets*. Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, Pretoria, South Africa, p. 68.
- Maertens, M., Swinnen, J.F.M., 2009. Trade, standards, and poverty: Evidence from Senegal. *World development* **37**, 161-178.

- McMichael, P., Myhre, D., 1991. Global Regulation vs. the Nation-state: Agrofood Restructuring and the New Politics of Capital. *Capital and Class* **43**, 83-105.
- Ménard, C., 2005. A New Institutional Approach to Organization, in: Ménard, C.a.S. (Ed.), *M. M. Handbook of New Institutional Economics*. Springer, Dordrecht, the Netherlands, pp. 281-318.
- Mighell, R.L., Jones, L.A., 1963. Vertical Coordination in Agriculture, *Agricultural Economic Report 19*. U.S. Department of Agriculture.
- Minot, N.W., 1986. Contract farming and its effects on small farmers in less developed countries, *MSU international development papers*. Department of Agricultural economics, Michigan State University p. 100.
- Miyata, S., Minot, N., Hu, D., 2009. Impact of contract farming on income: linking small farmers, packers and supermarkets in China. *World Development* **37**, 1781-1790.
- Municipal Demarcation Board, 2006. Municipal Profiles. <http://www.demarcation.org.za/MunicProfileOnline/index.aspx>, South Africa.
- DAFF (Department of Agriculture, Forestry and Fisheries) 2010. The Strategic Plan for the Department of Agriculture, Forestry and Fisheries. Department: Agriculture, Forestry and Fisheries, Pretoria, South Africa.
- National Planning Commission, 2010. Development Indicators 2010. The presidency of the Republic of South Africa.
- Ortmann, G., King, R.P., 2006. Small-scale farmers in South Africa: Can agricultural cooperatives facilitate access to input and product markets?, *Staff Paper series 06-4*. . Department of Applied Economics. College of Agricultural Food and Environmental Sciences. University of Minnesota.
- Ortmann, G.F., King, R.P., 2007. Agricultural Cooperatives I: History, Theory and Problems. *Agrekon* **46**, 40-68.
- Ortmann G.F., King R.P., 2010. Research on agri-food supply chain in Southern Africa involving small-scale farmers: Current status and future possibilities. *Agrekon* **49**:397-417.
- Pauw, K., Mncube, L., 2007. The impact of growth and redistribution on poverty and inequality in South Africa. International Poverty Center, *Country Study 7*. Development Policy Research Unit, University of Cape Town, Cape Town, South Africa.
- Perret, S., Anseeuw, W., Mathebula, N., 2005 Poverty and livelihoods in rural South Africa. Investigating diversity and dynamics of livelihoods. Case studies in Limpopo. , *Unpublished Project report 05/01*. University of Pretoria, Kellogg's Foundation, Pretoria, South Africa.
- Porter, G., Phillips-Howard, K., 1997a. Comparing Contracts: An evaluation of contract Farming Scheme in Africa. *World Development* **25**, 227-238.
- Porter, G., Phillips-Howard, K., 1997b. Contract farming in South Africa: A case study from KwaZulu-Natal. *Journal of the Geographical Association* **82**, 1-38.
- Poulton, C., Dorward, A., Kydd, J., 2010. The Future of Small Farms: New Directions for Services, Institutions and Intermediation. *World Development* **38**, 1413-1428.
- Vermeulen, H., Kirsten, J.K., Sartorius, K., 2008. Contracting arrangements in agribusiness procurement practices in South Africa. *Agrekon* **47**, 198-221.
- Vorley, B., Fearn, A., Ray, D., 2007. Regoverning Markets: A Place for Small Scale Producers in Modern Agrifood Chains? Gower, London, UK.

Wollni, M., Lee, D.R., Thies, J.E., 2010. Conservation agriculture, Organic marketing, and Collective action in the Honduran hillsides *Agricultural Economics* **41**, 373-384.

Wollni, M., Zeller, M., 2007. Do farmers benefit from participating in specialty markets and cooperatives? The case of coffee marketing in Costa Rica. *Agricultural Economics* **37**, 243-248.

World Bank, 2007. *World Development Report 2008: Agriculture for Development*. World Bank, Washington DC.

World Bank, 2011. *World Bank Data by Country*. <http://data.worldbank.org/country/south-africa>.

## Annex 1. Description of the Heckman model

The empirical specification of market participation and income from agriculture problem takes the following form:

$$Y_i = \beta X_i + \delta M_i + \varepsilon_i, \quad (1')$$

where  $Y_i$  is agricultural income,  $X_i$  denotes the explanatory variables that influence agricultural income, and  $M_i$  is the dummy variable indicating the market participation decision (binary choice). In case of self-selection, the least square estimator  $\delta$  will be biased, i.e. overestimating the effect of market participation. The solution lies in incorporating a standard treatment effects model, which extends the program participation model (1') with (Greene, 2000, Maddala, 1983):

$$\begin{aligned} M_i^* &= \gamma W_i + u_i \\ M_i &= 1 \quad \text{if} \quad M_i^* > 0, \text{ otherwise } M_i = 0. \end{aligned} \quad (2')$$

In reality,  $M_i^*$  is unobservable, whereas  $M_i$  is the dichotomous parameter of market participation (influenced by the set of explanatory variables  $W_i$ ) as directly measured in the survey. Hence, the probability of market participation (2') can be defined as:

$$\begin{aligned} \text{Prob}(M_i = 1) &= \text{Prob}(M_i^* > 0) = \text{Prob}(u_i > -\gamma W_i) = \Phi(\gamma W_i), \\ \text{and Prob}(M_i = 0) &= 1 - \Phi(\gamma W_i) \end{aligned}, \quad (3')$$

wherein  $\Phi$  is a cumulative probability distribution for  $u$  (Maddala, 1983). The distributional form of  $\Phi$  can either be a normal or logistic distribution. Since the issue of which probability distribution to use is unresolved (Greene, 2000), we assumed the distributional form of  $\Phi$  as the cumulative normal (with  $\phi$  representing the standard normal pdf) and as such the problem can be solved as a probit model.

Finally, the estimation of the linear regression model (1) will be:



$$\begin{aligned}
E[y_i|M_i=1] &= \beta X_i + \delta + E[\varepsilon_i|M_i=1] = \beta X_i + \delta + \rho\sigma_\varepsilon\lambda(-\gamma W_i) \text{ and} \\
E[y_i|M_i=0] &= \beta X_i + \rho\sigma_\varepsilon \left[ \frac{-\phi(\gamma W_i)}{1-\Phi(\gamma W_i)} \right]
\end{aligned} \tag{4'}$$

The factor  $\lambda(-\gamma W_i) = \frac{-\phi(\gamma W_i)}{1-\Phi(\gamma W_i)}$  is defined as the inverse Mills' ratio/lambda. As previously indicated, the estimation of this inverse Mills' ratio provides an answer to the issue of self-selection bias or whether the estimator of market participation in the linear regression is biased. This is shown by the expected difference in agricultural income between market participants and non-participants derived from (4') as:

$$E[Y_i/M_i=1] - E[Y_i/M_i=0] = \delta + \rho\sigma_E \left[ \frac{-\phi_i}{\Phi_i(1-\Phi_i)} \right] \tag{5'}$$